THE PROGRESSIVE FISH CULTURIST

NEWS AND VIEWS FROM MANY SOURCES ON PRACTICAL HATCHERY PROBLEMS

ISSUED BY THE

U. S. DEPARTMENT OF COMMERCE
DANIEL C. ROPER, SECRETARY

BUREAU OF FISHERIES
FRANK T. BELL, COMMISSIONER

APRIL - 1938

WASHINGTON

TABLE OF CONTENTS

	Page
NOTES ON the Introduction of Mexican Trout, by Paul R. Needham	1
MEAT DIET Supplements, and Their Effect on Growth and Health of Fingerling Trout, by Earl W. Stiles and Howard C. Russ	10
CREEL CENSUS as an Aid to Better Fish Stocking Program, by Harry A. Hanson	17
EDITORIAL: For Hatchery Men Only	20
COMMENTS FROM Our Readers:	
Easy Aeration of Fish Containers, by L. O. Nolf	21
NOTES AND NEWS:	
Start Sockeye Run in Nanaimo River System,	22
Baird Fish Culture Station Now Closed	22
REVIEWS:	
Tack, Dr. Erich: Trout Mortality from the Formation of Suspended Ice Crystals, by L. E. Wolf	26
Vetter, Heinz: Meat Substitutes for Feeding Trout, by L. E. Wolf	26
Hess, Walter N.: Production of Nutritional Cataract in Trout, by R. L. Carson	27

THE PROGRESSIVE FISH CULTURIST

A SERIAL memorandum published occasionally for the advancement of Federal, State, and private fish culture and fishery management in fresh waters.

Editor

Elmer Higgins, Chief, Division of Scientific Inquiry, U. S. Bureau of Fisheries.

Associate Editors

Dr. H. S. Davis, In Charge, Aquicultural Investigations, U. S. Bureau of Fisheries.
Professor Lauren R. Donaldson, School of Fisheries, University of Washington.
Dr. A. S. Hazzard, Institute for Fisheries Research, Michigan Conservation Department.
M. C. James, Assistant Chief, Division of Fish Culture, U. S. Bureau of Fisheries.
Dr. A. H. Wiebe, Biological Readjustment Unit, Tennessee Valley Authority.
Dr. Louis E. Wolf, New York Department of Conservation.

APPLICATIONS for this memo, which is distributed free on regular mailing lists, should be addressed to the Commissioner of Fisheries, Washington, D. C. Contributions for publication are welcome.

While a certain amount of editorial selection of material is exercised, the U. S. BUREAU OF FISHERIES DOES NOT NECESSARILY ENDORSE AND IS NOT RESPONSIBLE for the statements of facts nor for views and opinions published herein.

5907

THE PROGRESSIVE FISH CULTURIST

NEWS AND VIEWS FROM MANY SOURCES ON PRACTICAL HATCHERY PROBLEMS

ISSUED BY THE

BUREAU OF FISHERIES, U. S. DEPARTMENT OF COMMERCE

Memorandum I-131 Washington, D. C., April 1938 No. 37

NOTES ON THE INTRODUCTION OF MEXICAN TROUT

By Paul R. Needham, U. S. Bureau of Fisheries,
Stanford University, California.

IN ARID WESTERN regions we need a rainbow trout that will stay put when planted. Therefore, it was with keen interest that some four or five years ago I began to hear vague rumors of trout that were said to be non-migratory. Various streams in the mountains of Arizona, New Mexico, and California, were said to contain trout that by reason of natural barriers, or individual habit, were more or less non-migratory. Now hunting a non-migratory salmonid may be somewhat akin to seeking the fountain of youth. However, persistency of rumors, and discussions with various fisheries investigators led me to believe that such a trout could be found. We hoped that besides being non-migratory, it would also show purity of strain in the wild state, and greater adaptability to higher water temperatures.

Nelson's trout, Salmo nelsoni, of the Santo Domingo River on the Lower California Peninsula, Mexico, was selected for introduction after careful consideration. This stream flows westward into the Pacific Ocean some 150 miles south of the international border and forms one of the principal drainages of the Sierra San Pedro Martir mountains. It is the only stream on the Lower California Peninsula known to contain native trout. Accordingly, in May 1936 Fred Johnson of the U. S. Forest Service and the writer made a reconnaissance trip into Mexico to see if these trout were still available, and if so, to find out if it would be possible to get them out alive. We found nelsoni quite abundant and we figured about a fifty-fifty chance of getting

them back via truck into California alive. Therefore, in May, 1937, a year later, another trip was made to bring them back which was successful. Fifty specimens were collected and placed at the Forest Home State Hatchery in Southern California.

For years American fish culturists have been busily engaged in developing and improving fish cultural methods relating to feeding, equipment, and disease prevention and cures. The improvement of domestic strains of trout has not kept pace with other improvements and outside the work by Dr. G. C. Embody and C. O. Hayford in New York and New Jersey, and by Dr. H. S. Davis in Vermont and West Virginia, but little experimental selective breeding has been carried on. Egg supplies for hatcheries procured from wild sources permit but little control of the parent stocks to develop select strains. Domestic strains on the other hand "live" with the hatcheryman, so to speak, and selective breeding experiments can be carried on if desired.

Unfortunately, with all the recent improvement along many other lines, little attention has been paid to the hereditary backgrounds of the fishes we have been propagating and planting. As fish culturists know, a wild strain can be domesticated in time, and eventually it will become adapted to hatchery existence and do far better than wild stocks recently removed to hatcheries. The point here is that although any given strain of trout may be well adapted to hatchery life, it is not necessarily fitted for life in wild waters after planting. Indeed the very reverse may be true. Behavior <u>after</u> planting is more important than <u>before</u> planting if we think of the problem in terms of fish actually caught by anglers.

The migratory habits of rainbows particularly have caused fish culturists many assorted and sundry headaches. Downstream migrations often cause large annual losses from power, irrigation, and mining diversions into which downstream migrants merrily swim to their destruction when seeking either the ocean or larger bodies of water in following their age-old instincts. The rainbow series of trout, apparently, show more variation in this particular habit than either the brook or brown trout.

All salmonids are more or less migratory. Periodic migrations between breeding and feeding areas are well known. The steelhead, for instance, may migrate many hundreds of miles from the ocean to spawn while resident forms may migrate only short distances from stream to tributary, or from lake to tributary. Such similarity of appearance linked with such dissimilar migratory habits has naturally resulted in much indiscriminate inter-breeding and mixing of different races or strains through propagative activities until today it is pretty much anybody's guess as to the genetic constitution of most hatchery-reared brood stocks. The same might be said for wild waters where indiscriminate planting has so mixed up strains of native fish with introduced forms that in many instances native populations have been completely modified from their original character.

In order to obtain an absolutely pure strain of trout, that is, one in which we were certain no cross breeding had occurred with planted hatchery fish, it seemed desirable to go outside California. The fact that <u>S. nelsoni</u> is today the southernmost native coastal trout known on the west coast of North America led us to believe

that, aside from having retained its purity of strain, it might, in addition, show better than usual tolerance to high water temperatures due to its survival in a hot climate. Lastly, nelsoni seemed the best bet because of the possibility of its being non-migratory. It may not be possible to find a non-migratory type of rainbow, but at least by starting with a strain which has been forced by both climate and geographic barriers to forego downstream migrations for centuries such as S. nelsoni, the chances of developing such a trout would seem fairly good. Natural selection operating over a long period of time would probably assist in the development of just such a type of fish.

Salmo nelsoni was first collected by E. W. Nelson, former Chief of the Bureau of Biological Survey, U. S. Department of Agriculture, in 1905, during an extended exploration trip of the Lower California Peninsula. The specimens collected were turned over to Dr. B. W. Evermann, who described them as new (Evermann, 1908) and who named the species nelsoni. Nelson (1922) recorded briefly the fact that the trout were collected from the Santo Domingo River near the Rancho San Antonio and gave a few notes on the character and type of waters from which they were collected. Chester Lamb of the Museum of Vertebrate Zoology, University of California, again collected nelsoni from the same locality in 1925. His specimens were turned over to Dr. J. O. Snyder for study and Snyder (1926) gave a detailed comparison of these fish with several other members of the rainbow series. As noted both by Evermann (1908) and Snyder (1926), Salmo nelsoni in general appearance closely resembles typical rainbows and definitely belongs to the rainbow series.

Both Evermann and Snyder (loc. cit.) stated that in all probability the Santo Domingo River was stocked with rrout by natural extension from trout waters of the coast region of Southern California, the trout passing southward through the sea from stream to stream at a period when climatic conditions were favorable. Undoubtedly once these fish became established in the river they continued periodic migrations to and from the ocean as long as conditions remained favorable. However, climatic barriers occurring since that time stranded these fish in about seven miles of stream in the mid-portion of the river some thirty-five to forty miles from the ocean at an elevation of around 2,500 feet above sea level.

On the 1936 trip, the writer visited the mouth of the stream and found a high sand bar blocking the mouth with only stagnant, standing pools of water at scattered intervals along its course over the flood plain. No water was flowing into the ocean although signs that it does flow into the ocean during flood periods were quite evident. From inquiries made at neighboring haciendas on the lower river, no reports whatsoever were obtained regarding the presence of migratory fishes in the lower river. Sticklebacks were abundant but no young trout were either seen or collected.

As indicated above, two trips were made to the Santo Domingo River; a reconnaissance trip in May, 1936, and another to secure the fish, a year later. Fred Johnson of the U. S. Forest Service and the writer made the first trip. On the second we were accompanied by M. Hugo of the Forest Service, Everett Horn of the U. S. Biological Survey, and H. John Rayner of the U. S. Bureau of Fisheries.

San Antonio Creek valley looking toward the crest of the Sierra San Pedro Martir Mts. near the Rancho San Antonio: Baja California, Mexico. (Photograph by courtesy of Everett Horn, U. S. Bureau of Biological Survey)

San Antonio Creek near the Rancho San Antonio. Note heavy bed of flood-deposited granitic sand at left. (Photograph by courtesy of Everett Horn, U. S. Bureau of Biological Survey)

The party assembled in San Bernardino on May 18th with two light pick-up trucks and full equipment to secure the trout, including seines, aerators, buckets, six of the "pack" type fish cans, dip nets, wire screen for live cars, and four insulated ice containers in which 400 lbs. of ordinary ice and 50 lbs. of dry ice were carried south. In San Diego on May 19th a "permisio" was secured from Mexican officials and, loaded to the gunwales, we headed south for Ensenada some seventy miles south of San Diego. In Ensenada we stopped at the Hotel Savoy for the night, which place, in spite of its high-sounding name, is merely a tourist camp run by a little old Chinaman

After making final purchases in Ensenada and with the trucks pracically flat on their springs, we headed south for Valladares at the end of the road where pack stock was to meet us for the ten mile horseback trip into the stream. This place is only about 134 miles south of Ensenada, but what roads! It took two days to make it at the terrific speed of approximately eight miles per hour. The road served several purposes aside from merely that of transportation; in places it was used as an irrigation ditch, in others a means of flood control, in others as a goat trail, though I doubt whether goats would deign to use it. At times it had the most amazing habit of disappearing into the sagebrush and cactus in numerous branches and sub-branches. In one place we wasted two hours following blind leads until we ran across an hacienda and in bad Spanish found that we should go "a la derecha" (to the right) of "un corral" (a corral). The route followed was from Ensenada to San Vicente, Arroyo Seco, San Telmo, and Valladares. Each of these places except Ensenada consists of a small group of adobe houses usually with thatched roofs, a fresh-water well and small irrigated plots, and in some places a small "cantina" or store. Great interest and friendliness was shown by the Mexicans. Few cars were met on the roads and these were mostly of ancient vintage, well wired together, usually carrying no less than from ten to eighteen native occupants, all with a look of solemn ecstacy on their faces as they bounced along in unison giving forth strange noises, midst confusion and dust.

On arrival at Valladares the evening of May 21st, we were met by the two Mexican packers I had engaged by letter written February 5, 1937, or three months previously, to Senor Salve Meling at the Rancho San Jose some fifteen miles from Valladares. Lack of regular mail service south of Ensenada made it necessary to make this arrangement long in advance. Only a single reply was had from Senor Meling dated March 8th, and presto, both stock and packers were there on May 21st as specified. This was reliability if I ever saw it. The packers, Ignacio Iguerra and Estaban Llewellyn, had brought eleven head of stock which was ample for transportation of equipment and personnel to that section of the Santo Domingo River where the trout are found near the Rancho San Antonio.

Ignacio and Estaban were efficient packers though they remained somewhat aloof until they became better acquainted with us. Estaban spoke no English whatsoever while Ignacio understood it fairly well, though I think he much preferred to pretend lack of understanding so he could listen to us struggle with our rusty idiomatic expressions. Before the trip was over they became quite friendly and told us much about the country and their personal histories. Ignacio had served under Obregon and his reputation for handy work with the knife was well-known.

At 4:00 A.M. on May 22nd we broke camp and prepared for the pack trip to the Rancho San Antonio on the river. We left 350 lbs. of ice, which incidently was holding up beautifully in the insulated cases prepared for it, buried in the deep shade of a willow tree on the bank of Valladares Creek, and 100 lbs. was packed to the river in two 50-lb. cases. Just before we left Valladares, Senora Meling rode into camp garbed in chaps, sombrero, and other accountrements of ranchers in Baja California. She had ridden the fifteen miles from the Rancho San Jose before breakfast to see us off and proved to be a most intelligent and gracious woman, speaking perfect Spanish and English.

With a final "adios" to Senora Meling the trip began. It being late spring, flowers of all kinds were seen in great profusion. Whole hillsides were covered with the large white matillaja poppies, and the yellow St. John's wort. Cacti of many varieties were in full bloom adding bright spots of color. Enroute we collected one large rattlesnake about four feet long. Quail and pigeon were very abundant.

On arrival at the Rancho San Antonio lunch was quickly eaten and a survey was made for trout in two tributaries, Santa Cruz and San Antonio Creeks, that join here to form one of the main branches of the Santo Domingo River. Surprisingly enough young fry and fingerlings of S. nelsoni were exceedingly scarce, while on the previous trip in 1936, Johnson and I had found them very abundant. In fact, altogether we saw only two small fish of the year so we decided to take 50 yearling or older fish to bring back alive. Evidences of heavy winter flooding were abundant along the stream. Heavy silting by granitic sand carried down from the mountains above was seen everywhere. Many pools had been completely filled and for long stretches the stream showed only shallow, sandy-bottomed areas with very little cover for fish. Evidently most of this year's eggs and young had been destroyed by flood waters. However after much seining, by night we had 12 nelsoni in a screen cage in the stream next to camp. Johnson and Horn had caught twelve with rod so injured that they were eaten at the evening meal, much to my regret as I would have preferred to dunk them in formaldehyde. However, gastronomical research is a side of trout investiga tions that should not be neglected, and it may be said that they were most palatable in all ways, and of excellent texture and flavor.

May 23 being Sunday, we rested until 6:00 A.M., arising to a breakfast of Mexican tortillas prepared by the competent Ignacio. Serious collecting of trout was again begun and so scarce were they that by 11:30 A.M. only 19 had been caught. San Antonio Creek was practically barren of fish though one or two could be seen in about every 400 yards of stream. In Santa Cruz Creek we had better luck just before lunch. We inquired of the Mexican at the Rancho San Antonio where "las truchas" (the trout) were "mas numeras" (most abundant). He assured us that "arriba rio las truchas estan muy numeras" (upstream the trout are very abundant). So upstream we went on Santa Cruz Creek and found "las truchas" as he had described. After netting twenty-four additional yearlings and two-year olds, we returned to camp about 1:30 P.M. These, with those taken earlier, gave us a total of fifty-five which we figured was about all we could handle with the equipment at hand.

The next day, May 24, we arose at 4:00 A.M. and prepared for the first lap of the return journey to Valladares. Water in the stream at 58°F. was placed in the cans and iced down to 45° F. after which fish were placed in them. Four of the larger fish around eleven inches were killed and preserved in formaldehyde as we did not want to risk over-loading of the cans. Of the fifty-one others, five cans contained eight fish apiece and one can had eleven fish.

Rayner and I with Estaban, then set out immediately for Valladares to take advantage of cool early morning air temperatures. Johnson, Horn, Hugo, and Ignacio followed later with remaining equipment at a more leasurely pace. The ride up the trail out of the canyon in which the streams lie was made in good time. Once at the crest of the divide about half-way to Valladares, we stopped for a looksee at the fish. They were doing nicely and staying down on the bottom of the cans where all well-behaved fish remain when in transit. Temperature of water varied between 48° F. and 55° F. The remaining ice was distributed among the cans as the air was becoming quite warm and we again took off.

Arrived in Valladares without any casualities among the fish at 9:30 A.M. We had planned to "rest" the fish in Valladares Creek the remainder of the day and one night prior to leaving the next morning via the trucks for the North. This would also give the members of the party a good chance to rest up. The temperature of Valladares Creek was already up to 76° F. and it was still comparatively early in the day so it was with some misgivings that Rayner and I tempered the water in the cans from about 55° up to 76° F., after which we placed the fish in a wire cage in the stream. In so doing we lost our first fish that flopped from a can into the creek instead of into the cage. A canvas tarp was then placed carefully over the cage, both to prevent the fish from leaping out and to keep out strong sunlight. With thermometers in hand, so to speak, we waited future developments. Inside one hour the temperature stealthily advanced to 77° F.; another hour and it reached 78°, and finally "rang the bell" at 80° F. This was a critical period and we were beginning to think that maybe it might be better if we had bass, sunfish, or even a goldfish, instead of trout Since about 83° F. is generally considered the maximum tolerance of rainbows and since our fish had already taken a beating on the pack trip out from the river to Valladares, if the temperature were to increase still further it would be necessary to place them in the cans again, ice down, and head north on the final lap at once. A few of the fish had grown weak and were washed crosswise against the wire at the lower end of the cage by the current, so we built a small rock dam at the upper end to break the force of the current. Aside from some slight restlessness, on the whole they seemed in good condition so we waited further developments with fingers crossed.

For about the next hour and a half the temperature held right at 80° F., but no fish died. Finally and to our intense relief, the temperature began to drop as the afternoon advanced and we knew that we were over that hurdle. By nightfall the water temperature was down to 60° F.

The next morning all the fish were alive and active so we dug up the remaining 350 lbs. of ice, packed goods, placed the fish in cans after icing the water down, and set out on the long trek north at 6:00 A.M. And right here we had another lucky break; the day turned out cool and foggy; ideal weather for the transportation of fish

The writer taking temperature of Valladares Creek while S. nelsoni are "rested" in wire cage under tarp prior to truck trip north. Note pack cans in background. (Photograph by Courtesy of Everett Horn, U. S. Bureau of Biological Survey)

Rayner hand-areating S. nelsoni in cans en route north from Valladares. Note 400-lb. insulated ice case on left side of truck.

On the evening before leaving, we contacted F. N. Cronemiller and Mr. Evarts of the U. S. Forest Service who were camped near San Telmo some 31 miles distant from Valladares, with the aid of a short wave radio set, and by arrangement met them en-route at San Telmo at 9:00 A.M. The descanso Ranger Station in San Diego County was also contacted the evening before. Hugo was able to put a message through to his wife that he would be delayed until late the next night. Many are the advantages of living in this modern age.

The fish were iced only twice before arrival in Ensenada at 7:00 P.M. Aeration was necessary only at infrequent intervals, as the roughness of the road performed this function most effectively. In Ensenada we made several purchases, had dinner, and proceeded north. We arrived at San Diego at 11:45 P.M. where suitcases and other materials left there were picked up.

John Rayner and I left at once for the Forest Home Hatchery near Redlands, while Johnson, Horn and Hugo remained in San Diego over night. In San Diego, believe it or not, it was raining. We were stopped by a U. S. Border Patrol Car a short distance out of San Diego, and the driver must not have been a native son, for he suggested that we "turn the fish loose and let them swim home".

Fog further delayed progress so that we did not arrive at the Forest Home Hatchery until 4:30 A.M. on the morning of May 26. Here we aroused D. A. Clanton, Superintendent of the Hatchery, and with his assistance placed the fish in a concrete raceway.

All 50 fish with which we left Valladares arrived in fine condition at their destination. At no time during the course of the trip did they show signs of distress. After good roads were reached, hand aeration became necessary at least once every half hour. Ice was also necessary to maintain a temperature of between 45° and 55° F. in the cans. The water was not changed in the cans at any time after leaving Valladares and it was quite murky with road dust by the time the Forest Home Hatchery was reached. When the trout were placed in a hatchery raceway, they immediately darted to shelter in the upper end of the pool, showing very vigorous movements which gave further evidence that they suffered no immediate ill effects from the trip. We returned to a hotel in Redlands for some sleep at 7 A.M.

The "permisio" given us by Mexican officials permitted prompt passage over the border both going and coming. Customs officials were most courteous and cooperative wherever contacted. Throughout the journey, natives were invariably helpful and a more friendly people could not be found anywhere.

The introduction of S. nelsoni is a "long shot" to be sure, and many are the catastrophies that can happen to nullify these efforts. However if the fish survive and if we are able to grow a brood stock of these trout, the young of which can be used for experimental plantings, the practical fish cultural and general biological information obtained should prove of considerable value. The question of importance is, will these fish hike straight for the ocean and revert to their age old migratory habits if they are planted in streams giving easy, safe access to the ocean? Obviously, only experimental plantings carefully followed out will give the answer to this and other questions with regard to these fish. In any event, we have the fish and with luck, intend to collect on that free ride north. When last heard from only two had died since arrival and the rest are doing fine under the expert care of Dorrence Clanton at the Forest Home Hatchery.

5907

LITERATURE CITED

Evermann, Barton Warren

1908. Dscriptios of a new species of trout (Salmo nelsoni) and a new cyprinodont (Fundulus meeki) with notes on other fishes from Lower California. Proc. Biol. Soc. Wash., Vol. XXI, 1908, pp. 19-30.

Nelson, E. W.

1921. Lower California and its natural resources. Mem. Nat. Acad. Sci., Vol. XVI, 1st Memoir, 1921 (1922), pp. 1-194.

Snyder, John Otterbein

1926. The trout of the Sierra San Pedro Martir, Lower Calfornia. Univ. Calif. Pub. Zool., Vol. 21, 1926, pp. 419-426.

Note: Four S. nelsoni females introduced from Mexico, as noted above, were spawned at the Forest Home Hatchery, February 17, 1938. A total of 1,982 eggs were obtained. Ten other females were found about ripe and will be spawned later this spring. Thus, with good luck, around 5,000 young first generation offspring of this strain of fish should be available later this year both for future brood stock and experimental plants with this species.

MEAT DIET SUPPLEMENTS, AND THEIR EFFECT ON GROWTH AND HEALTH OF FINGERLING TROUT

By Earl W. Stiles and Howard C. Russ
State Fish Hatchery, Caledonia, N. Y.

WITHIN THE PAST few years meat supplements have gained favor with fish culturists throughout the country. The use of such food concentrates as fish meal, salmon egg meal, dry milk products, etc., has become necessary because of the high price of fresh meat. In the New York State hatcheries many of these dry products have given very satisfactory results when used in combination with various kinds of fresh meats, but in the Caledonia Hatchery trouble was experienced from the very beginning of our attempts to use dry meals in the trout food. Because of this trouble the experiment herein described was performed.

During the summer of 1936 a series of preliminary diet experiments was run at Caledonia. The results from these experiments proved so interesting that it was decided to carry on further tests of this nature in 1937. These 1937 experiments are herewith described, the account being divided into two parts; Part I is the work carried on at the hatchery proper, and Part II the work at the springs from which the hatchery stream flows.

PART I

In accordance with the suggestion of A. V. Tunison of the experimental hatchery at Cortland, New York, the following diets were formulated and put into use for a ten weeks period from July 7 to September 15.

Dry feed mixtures and meat supplements: (parts by weight) 1/

	Diet No. 1	No. 2	No. 3	No. 4
Dry skim milk	14.75	9.75	4.75	00
Cotton seed meal	14.75	9.75	4.75	00
Whitefish meal	14.75	9.75	4.75	00
Salmon egg meal	14.75	9.75	4.75	00
Salt	1.00	1.00	1.00	00
Beef liver	20.00	30.00	40.00	50.00
Beef heart	20.00	30.00	40.00	50.00
	100.00	100.00	100.00	100.00

Diet 1A. Dry buttermilk substituted in diet 2 for dry skim milk.
Diet 1S. Seal meal substituted in diet 2 for salmon egg meal.

Diet L.B.H.	Beef liver	49.50
	Beef heart	49.50
	Salt	1.00
		100.00

Diet '36	Dry skim milk	20.00
	Whitefish meal	20.00
	Salmon egg meal	10.00
	Beef liver	15.00
	Beef heart	35.00
		100.00

1/ Parts by weight on an "as purchased" basis.

The meat substitutes were weighed and mixed dry. One pound of water was added for each pound of dry constituent in the diet. The percentage of body weight fed each day was taken from the dry weight of the diets plus the meat and corrected for the water added to the mixture. The percentage in body weight to be fed daily was taken from THE NEW YORK STATE FISH HATCHERY FEEDING CHART appendix TABLES APPLICABLE TO HATCHERY OPERATIONS, Charles R. Deuel, David C. Haskell and A. V. Tunison 1937. The fish were weighed each week and the amount of feed increased as their gain merited.

Four species of trout were used as subjects, and were divided into twenty lots; eight lots of brown trout Salmo fario, four of rainbow trout Salmo irideus, four of brook trout Salvelinus fontinalis, and four lots of lake trout Cristivomer namaycush. Standard hatchery troughs of 5.86 cu. ft. capacity were stocked with 2.93 lbs.

of fish, or 1/2 lb. per cu. ft., and the flow of water set at fifteen gallons per minute. The fish of each species were of the same size and equally exposed to disease when placed in the experiment because they were taken from the same trough in production. At the beginning of the experiment the brook trout were approximately 2-1/2 in. long and weighed 153 fish to the pound, the browns 1-3/4 to 2 in. long and weighed 352 to the pound, the lakes 2-1/4 in. long and weighed 306 to the pound and the rainbows 2-1/4 in. long and weighed 214 fish to the pound.

A summary of the results obtained is given in Table I. No disease control measures of any kind were taken with these lots of fish, and at the end of the experiment the fish from each lot were examined individually for the several diseases which had appeared during the course of the experiment. The results of this examination are given in Table II. The data presented in these tables is analyzed in the section of the paper headed "Discussion".

TABLE I. Summary of Feeding Experiments at the New York State Hatchery, Caledonia, New York.

July 7, through September 15, 1937

Species	Diet	Lb. st.	Lb. end	Lb. gain	%gain	Conv.	Cost	Cost Prod.	% Mort.
Brown	1	2.93	6.69	3.76	127.9	5.58	.0805	.449	5.8
"	2	"	7.39	4.46	152.2	5.61	.09	.505	15.2
"	3	"	8.50	5.57	190.1	4.46	.1018	.47	.8
"	4	"	7.49	5.01	170.9	5.14	.1088	.559	.6
"	1A	"	7.00	4.07	138.9	5.43	.0914	.516	20.2
"	1A	"	6.38	3.45	117.6	5.97	.0854	.5098	36.1
"	LBH	"	9.00	6.07	207.2	4.15	.1084	.4498	.8
"	'36	"	6.00	3.07	104.8	7.2	.0827	.595	26.9
Rainbow	1	"	7.19	4.26	145.4	5.04	.0805	.4057	4.4
"	2	"	7.64	4.71	160.8	4.78	.09	.43	1.3
"	3	"	7.89	4.96	169.3	4.79	.1018	.4876	.6
"	4	"	8.42	5.49	187.4	4.18	.1088	.45	.3
Brook	1	"	3.90	.97	33.1	27.59	.0805	2.22	41.2
"	2	"	8.63	5.70	199.4	4.47	.09	.4023	13.5
"	3	"	8.83	5.90	201.3	5.17	.1018	.526	.9
"	4	"	13.13	10.20	347.9	3.1	.1088	.337	1.2
Lake	1	"	2.69				.0805		61.3
"	2	"	5.00	2.07	70.6	10.36	.09	.9324	35.2
"	3	"	8.75	5.82	198.6	4.09	.1018	.56	5.7
"	4	"	9.19	6.25	213.4	3.94	.1088	.4286	6.7

Lb. st. is the number of pounds of fish at the beginning of the experiment.
Lb. end is the weight of the fish at the end of the experiment.
Conversion is the number of pounds of food fed for each pound gain in weight of fish.
Cost is the cost per pound of each diet.
Cost Prod. is the cost of producing one pound of fish (Conversion multiplied by cost per pound of feed.)

TABLE II. Summary of the percent of infection in twenty lots of trout at end of experiment

Species	Diet	Ulcer	Finrot	Popeye	Total Infected	Clean	No. exam.
Brown	1	.2	99.3	.3	99.8	.2	950
"	2	1.5	75.1	.6	77.2	22.8	861
"	3	.1	68.6	.6	69.3	30.7	1013
"	4	.6	9.2	.7	10.5	89.5	1016
"	1A	5.8	93.3	.5	99.6	.4	794
"	1S	.6	87.6	.3	88.5	11.5	636
"	LBH	.1	32.9	.8	33.8	66.2	987
"	36	6.2	90.3	.1	96.6	3.4	755
Rainbow..	1		93.6	.2	93.8	6.2	614
"	2		66.0	.7	66.7	33.3	612
"	3	.1	18.4		18.5	81.5	621
"	4		1.1		1.1	98.9	611
Brook.....	1	17.7	66.5		84.2	15.8	316
"	2	1.4	92.7	.3	94.4	5.6	357
"	3	.2	77.6		77.8	22.2	402
"	4	.5	27.5		28.0	72.0	440
Lake.....	1	77.3	3.1	2.5	83.9	16.1	319
"	2	17.8	18.8	2.6	39.2	60.8	537
"	3	1.9	8.0	.1	10.0	90.0	812
"	4	9.7		1.8	11.5	88.5	823

PART II -

From the results obtained during a ten weeks period in the summer of 1936, in which a comparison was made between various meat supplements and a 100 percent meat diet, the results found in Tables I and II during the summer of 1937 were anticipated. The water used in these experiments came from a stream inhabited by adult trout and into which the effluent from a commercial trout hatchery flows about 1/4 mile upstream. It was thought that these factors affected to some extent the results obtained when dry foods were used. With this in mind we took five troughs of fish to the springs which are the source of the hatchery stream and there ran them in the fresh, uncontaminated water, which was not inhabited by fish of any kind. The temperature of this water was 48 degrees F. with a variation of less than one degree during the ten weeks period.

The troughs used in this experiment had a capacity of 11.8 cu. ft. and were stocked at the rate of 1/2 lb. of fish to each cu. ft. or 5.9 lbs. of fish per trough. Two lots of brown trout, one of brooks, one of rainbow, and one lot of lake trout were used as subjects. One lot of brown trout was fed on diet 4, which was called the control in the work in 1937, as it was the previous summer of 1936. The remaining four lots were fed diet 2 which, be it recalled, was made up of 30 percent each

of fresh beef hearts and beef liver, and 40 percent dry products. The results from the use of these diets will be seen in Table III.

TABLE III. Summary of results obtained with diet 2 in FRESH UNCONTAMINATED WATER SUPPLY

Species	Diet	Lb.st	Lb.end	Lb.gain	%gain	Conv.	Cost	Cost Prod.	%Mort.
Brown.....	4	5.9	11.00	5.10	86.4	6.28	.1088	.68	2.5
"	2	"	13.25	7.35	124.6	4.52	.09	.41	2.3
Rainbow	2	"	12.69	6.79	115.1	4.78	.09	.43	.3
Brook	2	"	18.00	12.10	205.1	3.56	.09	.32	1.0
Lake	2	"	14.25	8.35	141.5	4.39	.09	.40	.6

An individual examination of these fish for disease at the end of the experiment resulted in the data appearing in Table IV.

TABLE IV. Summary of per cent of infection in five lots of trout at end of experiment

					Total		
Species	Diet	Ulcer	Finrot	Popeye	Infected	Clean	No. Examined
Brown....	4	.65		.75	1.4	98.6	2000
"	2	.19	.5	.4	1.1	98.9	2182
Rainbow	2			.08	.08	99.92	1283
Brook....	2		10.6		10.6	89.4	850
Lake.....	2				0	100.0	1770

DISCUSSION

Part I. The diets used in this experiment have already been given in detail. Comparing the amounts of meat and dry meals we find the following:

	Meat	Meals			Meat	Meals	Salt
Diet 1	40	60	Diet 1A		60	40	
" 2	60	40	" 1S		60	40	
" 3	80	20	" LBH		99		1
" 4	100		" '36		50	50	

Consider for the moment, diets 1 through 4 only; without exception diets 3 and 4 produced the greatest gains in each species. Diet 4 produced the largest gains except in the brown trout in which diet 3 held a 19.2 percent lead at the end of the ten weeks period. The poorest results were obtained with diets 1 and 2, diet 1 being the poorest. A comparison of the average percent gain over the period appears as follows:

Diet 1 –	average	gain	of	four	species	– 76.6	percent
Diet 2 –	"	"	"	"	"	– 145.75	"
Diet 3 –	"	"	"	"	"	– 189.8	"
Diet 4 –	"	"	"	"	"	– 229.9	"

The best conversion was obtained with the all-meat diet, except in the case of the brown trout where again diet 3 was the best.

In the cost of production, the four species were divided equally between diet 1 and 4. Diet 1 showed the lowest cost to produce a pound of brown trout and a pound of rainbows, while brooks and lakes were produced cheapest on diet 4. An average of the cost of production in the four species, however, shows the following:

Diet 1 –	cost	of	producing	a	pound	of	fish	– $1.02
Diet 2 –	"	"	"	"	"	"	"	– .57
Diet 3 –	"	"	"	"	"	"	"	– .511
Diet 4 –	"	"	"	"	"	"	"	– .444

The above cost figures are affected to a large extent by the extraordinarily high mortality in each species fed on a high percentage of dry food. An average of the mortality in four species appears:

Diet 1 –	average	mortality	in	four	species	– 28.175	percent
Diet 2 –	"	"	"	"	"	– 16.3	"
Diet 3 –	"	"	"	"	"	– 2.0	"
Diet 4 –	"	"	"	"	"	– 2.2	"

Of the remaining four diets in Part I of this experiment IA and 1S are similar to diet 2. The percentage of dry ingredients is the same, the only difference being in the composition of the diets. Diet LBH is a 99 percent meat diet with 1 percent salt added. The salt added to the meat when it is ground gives it a gummy consistency and prevents the loss of some of the water soluble components of the livers and hearts thereby producing a better conversion. Diet '36 is a 50 percent dry food mixture and the same as one of the diets used in the experiments in the summer of 1936. The effects of this diet seem to be a small gain, poor conversion, high cost of production, and a high mortality.

Considering Table 2 of the above experiment, we see there is a wide variation in the percentage of infection in the lots fed on the various diets. An average of the total percent of infection follows:

Diet 1 –	average	infection	in	4	species	– 90.4	percent
Diet 2 –	"	"	"	"	"	– 69.4	"
Diet 3 –	"	"	"	"	"	– 43.9	"
Diet 4 –	"	"	"	"	"	– 12.8	"

The above percentages are based on an examination for three common hatchery diseases, popeye, finrot, and ulcer disease. Finrot was by far the most prevalent, and, while considered by many practical hatcherymen as of minor importance, its presence in epidemic proportions in most of the lots of trout fed on the dry diets augmented the mortality column no small amount.

Part II. This part of the experiment was carried on at the same time as Part I. The water supply was fresh and uncontaminated, direct from the springs that are the source of the hatchery stream. Diets 2 and 4 were the only diets used. One trough of browns was fed on the all-meat diet. One trough each of brocks, browns, lakes and rainbows was fed on diet 2 which was the 40 percent dry meal and 60 percent meat mixture. The results obtained with this test were almost the reverse of those from Part I. The dry diet produced an average gain of 146 percent while the meat diet could be credited with only an 86.4 percent gain over the same period. The percentages of mortality with the meat was 2.5 while the average mortality with the dry food was 1.5 percent. The amount of disease infection in any of the lots was very small. The cost of producing a pound of trout on the all-meat diet was $.68 while on the dry diet the average cost was $.39 or cheaper than the average cost with the pure meat in Part I, which was the cheapest for that part.

CONCLUSIONS

It was our purpose in securing these data to discover, if possible, the reason for the poor results obtained with dry meal mixtures at the Caledonia Hatchery. Since the only variable in Part I was the diet, we were forced to the conclusion that the primary cause of the small gains and high mortality was the incorporation of dry meal supplements in the meat diet.

However, an examination of the evidence produced by Part II of this experiment shows that the meal and meat mixture surpassed the meat in lower cost of production, percentage gain, and conversion of food into fish flesh, when used in a clean water supply with a temperature of 48 degrees F.

Therefore, the results of Part II would disprove the belief that the dry meals were the primary cause of the poor results in Part I, and place them in a secondary position to water supply and temperature. We have in Part I a contaminated water supply, with a temperature of 52 degrees F., giving results much in favor of an all-meat diet, and in Part II a fresh, uncontaminated supply with a temperature of 48 degrees F., giving results in favor of a diet containing 40 percent dry meals.

All other conditions being equal, a temperature of 52 degrees F., should be a better growing temperature than one of 48 degrees F. Therefore, in view of the fact that the diets high in dry meals gave poor results in the form of small gains in weight, high mortality, and a high percentage of infection when used in a water supply inhabited by adult fish, and containing the effluent from a commercial hatchery the vigor of the fish, and the ability to combat disease, must have been lowered by the use of dry foods.

A CREEL CENSUS AS AN AID TO A BETTER FISH STOCKING PROGRAM

By Harry A. Hanson, Assistant Conservationist
U. S. Forest Service

THE U. S. FOREST SERVICE is conducting a creel census of fish taken from lakes and streams, which lie in the more remote alpine sections of the Snoqualmie National Forest in the State of Washington, for the purpose of aiding in formulating a sound stocking program.

Census cards are issued by Forest Service officers to anglers at the time the anglers receive their campfire permits. These cards read as follows:

Forest_____District_____

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

You are requested to fill out answers to questions below and deposit this card in any U. S. mail box. No stamp required. No signature necessary. Information obtained from this census will be used by the Forest Service in a stream and lake improvement program (Twp. Range Section
NAME OF LAKE_____LOCATION(
NAME OF STREAM_____LOCATION(
NO. OF DAYS FISHED_____TOTAL NO. FISH CAUGHT_____

No.	Kind of Fish	Avg. Lgth.	No.	Kind of Fish	Avg. Lgth
	Rainbow Trout			Dolly Varden Trout	
	Cutthroat "			Silver "	
	Mont. Blk. Spot			Eastern Brook "	
	Other			Other	

Check Condition of Fish Fat Medium Poor

IF YOU DID NOT FISH CHECK HERE

Each fisherman is requested to fill in the card and deposit it in any U. S. mail box. The cards require no postage or signature but are questionnaires for certain data about the fish taken, species, length, number, condition, etc.

Census cards for 1936 and 1937 have been returned, tabulated, and summarized. A few interesting results from the tabulations are shown in the following table:

SUMMARY OF CENSUS CARD DATA

	1936	1937
Total No. of cards returned by anglers	744	755
Percent of cards returned by anglers	20	19
No. of fish caught in lakes by anglers reporting	9846	7512
No. of fish caught in streams by anglers reporting	4794	8104
No. of fishing efforts reported in lakes	912	960
No. of fishing efforts reported in streams	490	1006
Average No. of trout per fishing effort from lakes	9.44	7.82
Average No. of trout per fishing effort from streams	12.5	8.0
No. of streams fished by anglers reporting	32	27
No. of lakes fished by anglers reporting	66	72
Estimated areas in acres of lake surface	2000	2200

If the returned cards represent a fair sample of the total yield, approximately 2,000 acres of lake surface produced during each season at least 5 times as many trout as were reported by fishermen, or roughly 47,000 and 37,500 respectively for the two years 1936 and 1937. This would represent an average yield of 23.5 trout per acre of lake surface in 1936 and 18.7 per acre of lake surface in 1937. That is not the whole story, however, for many visitors to the Forest camped and fished at improved camp grounds where campfire permits were not required and therefore did not receive census cards. Many others who made one-day fishing trips into the Forest and did not obtain permits likewise did not receive census cards, and an unknown number of others failed to call at ranger stations for permits because of the inconvenience or through ignorance of the requirement for permits. Therefore, the number of fish taken and reported by anglers probably represents far less than a fifth of the total catch.

What does a yield of 20 trout per acre of lake surface mean in relation to the existing food supply? A most important source of fish food is provided by bottom dwelling organisms, of which midge larvae and pupae (immature stages of a small mosquito-like fly) are probably most important. Midge larvae contribute a large percentage of the food of trout as shown by analysis of stomach contents; they occur in greater numbers than any other bottom dwelling forms and they are available to the fish throughout the year. A recent survey of 35 lakes on the Snoqualmie National Forest conducted by the Forest Service in accordance with the standard practice methods of the U. S. Bureau of Fisheries has shown an average midge larva and pupa population of approximately 63 per sq. foot of lake bottom.

If the average weight of a midge larva or pupa is 2 milligrams (a figure arrived at by taking the weight of 300) and we assume that the samples are representative of a uniform distribution of these organisms in the several lakes we can translate the numbers to weights per unit of area. Calculated on the basis of pounds per acre we arrive at a figure in the neighborhood of 40 pounds per acre. Stomach examinations of trout taken from the 35 lakes sampled showed that midge larvae and pupae contributed about 30 percent, by weight, of the food consumed.

Since it is well known from numerous hatchery experiments that it requires from 6 to 10 pounds of food to produce a pound of fish we can calculate the approximate amount of food necessary to produce any number of fish. If we assume that there exists in the 35 lakes sampled a standing crop of midge larvae of 40 pounds per acre and it takes 8 pounds of food to produce a pound of fish, an acre should produce 5 pounds of fish per year on the basis of midge larvae alone. Since midge larvae constitute 30% or in round numbers one-third of the food supply, an acre of water should produce about 15 pounds of fish. If the average weight of a trout taken from the lakes is six ounces (any angler will say that is conservative) 15 pounds of trout will equal 40 fish. Therefore, 40 fish per acre per year would represent a "maximum" production of the lakes sampled under existing food conditions. Obviously, the foregoing is intended to illustrate the order of magnitude in the relationship between the "crop" or the number of fish caught and the "carrying capacity" or existing food supply in the lakes and not intended as a final analysis upon which to base a management plan.

If one speculates for a moment on the total catch of trout in the Snoqualmie National Forest from lakes and streams, which are accessible only by trails, he finds from this summary that the lakes produced approximately 40,000 legal size trout each of the last two years, and the remote streams produced roughly 30,000 legal size trout each year. If this total of 70,000 fish is stated by weight, it may be more easily visualized, i.e., 70,000 fish at three to the pound, totals 23,300 pounds or about twelve tons. It is believed that this approximation is conservative as the average weight is probably greater than 5-1/3 ounces per fish and the total catch more than 70,000 fish.

Is 40,000 fish from 66 or 72 alpine lakes an optimum yield consistent with the food supply? What is an optimum yield consistent with the food supply and good growth? How many fish must be planted to maintain the best yield in headwater lakes and streams in the National Forest? These are important questions which must be answered if lakes and streams are to continue to be good places to fish.

The answers to these questions are not readily obtained. State and Federal agencies and several sportsman's organizations are working in cooperation to obtain the answers to these basic questions; but that is not enough. Every angler who casts a fly or drops a worm, grasshopper, or salmon egg into a stream or lake must realize his responsibility toward the proper management of public waters if he expects to continue to return year after year to catch fish in his favorite lake or stream. Every fisherman may consider the number of fish he takes as his own personal business but unless the agency responsible for restocking the waters knows the number and kind of fish removed it cannot be expected to maintain streams and lakes at their maximum production.

5907

An Editorial

FOR HATCHERY MEN ONLY

"YOU WILL BE interested in the reaction of our supervisors of fisheries operations to THE PROGRESSIVE FISH CULTURIST as given during our recent conference," writes one of our associate editors recently. "This journal," he continued, "was one of the topics for discussion, and comments by the various supervisors and their assistants were requested. In all cases comments were highly favorable toward the magazine as it is now prepared. I thought they were merely being polite, but in the hour's discussion which followed, in which a considerable number of recent articles were discussed, I realized that the men were sincere in their expression of interest in the publication and had apparently studied at least some of the articles very carefully. Several did express the feeling that more discussion of hatchery problems by fish culturists would be desirable. This gave me just the opening I had been looking for, and I told them that the reason more of these discussions had not been included was that most fish culturists were exactly as they were – either too busy or not inclined to take the pen in hand. I think most of them saw this point, and since then I have received several short discussions which I shall forward shortly."

The Editor has been keenly aware during the past few months of the prevalence of material contributed by technical workers in the field of aquiculture. Their continued interest in hatchery problems is gratifying and their contributions are most welcome. While much of this material may be regarded as fundamental, some of it lacks immediate and practical applicability to daily problems. Fish culturists themselves must supply this material.

It is perfectly natural for the hard-worked hatcheryman to leave the job of writing to the white-collar help but articles from this source alone present only one side of the progress made in fish culture. The experience from practical application is equally necessary if this progress is to be aided. Of course you are glad to receive new ideas from other workers in your field but you can't stay on the receiving end indefinitely. You must contribute some of your own ideas and experiences yourself if the product is to be worthwhile.

We have urged you before to take out a "patent" on your new ideas by describing them in print. No one will lose by sharing his "inventions" and everyone will profit. The usefulness of this journal will be seriously impaired if the technical aquiculturists are depended upon to supply all the copy. You hatcherymen owe it to your profession to make your contributions likewise.

Let us have your questions, your comments, your new ideas, your tested experiences and above all your criticisms. Let no statement of doubtful value go unchallenged through a sense of reticence or false modesty. Call a space a spade and write to THE PROGRESSIVE FISH CULTURIST.

THE EDITOR

COMMENTS FROM OUR READERS

EASY AERATION OF FISH CONTAINERS.

Editor, The Progressive Fish Culturist.

In reply to your inquiry concerning the device mentioned for the aeration of fish, the following is a brief note that you can use. Inasmuch as it has considerable possibilities for wide application I thought you might wish to relay it to others. We were using the fish for parasitological experiments and it was necessary that we keep them separated. Otherwise larger units would have been used.

In the fall of 1936, we faced the problems of transporting some experimental sheepshead a distance of 300 miles. The solution of the problem was aeration of the containers by using the vacuum which operates the windshield wiper of the car and a container for the fish that could be made air tight. Since the fish were under 6 inches in length we used wide-mouthed gallon pickle jars with tin screw top lids. We made a hole in the tin lids and fitted two hold rubber stoppers containing two short pieces of glass tubing. On the lower end of one glass tube, we placed a piece of rubber tubing long enough to reach the bottom of the jar. On the outside end of the other glass tube, we connected a piece of rubber tubing of sufficient length to connect directly to the motor intake for the operation of the windshield wiper. Several of these jars were hooked in series. A handful of water plants placed in each jar reduced the splashing, since the jars were only about two-thirds full of water and fish.

Although it was the latter part of August and the day was quite hot, we did not lose a fish. Last summer I transported several hundred blue gills and red-eared sunfish in about 5 gallons of water without losing any.

The same principle applied in the laboratory permits the utilization of more experimental units without the danger of cross infection or accidental infection from running water. In the laboratory we use a water pump as an aspirator.

L. O. Nolf,
State University of Iowa,
Iowa City, Iowa.

NOTES AND NEWS

START SOCKEYE RUN IN NANAIMO RIVER SYSTEM

(Reprint from CANADIAN FISHERMAN, Vol. 25, No. 3, March, 1938)

Nature put no Sockeye salmon into the Nanaimo River system on Vancouver Island but perhaps Man is going to make good the oversight. At all events, Sockeye swam in the river this year and they were apparently some of the fish which had developed from eggs planted in the stream several years ago by the Fish Culture Branch of the Dominion Department of Fisheries. Twenty-one of the salmon were taken in some test fishing which the department carried on in the Nanaimo during summer weeks and more than a hundred of their cousins and their uncles and their aunts were seen in one of the river's pools by a fisheries guardian in the course of his patrols.

An examination of the Nanaimo system with a view to ascertaining whether or not a Sockeye run could be established there was undertaken a few years ago at the request of the Nanaimo Board of Trade. Physical conditions were found to be apparently fairly suitable, although there were two possible adverse factors--plankton seemed rather scarce and there was a large trout population. In the late winter or early spring of 1933 the fish culture people planted in the river over a million Sockeye eggs from their Rivers Inlet hatchery. The eggs had been collected in the autumn of 1932 and as the Rivers Inlet Sockeye are very largely 5-yea. fish--that is, the fish hatched from the eggs of one year return from the sea as mature salmon five years later--any run to the Nanaimo system would make its appearance in 1937.

When Sockeye were taken in the river during the past summer they were examined by the staff of the Pacific Biological Station and were identified as 5-year fish. In other words since the Nanaimo is not naturally a Sockeye water, there was good reason to believe that the 1937 fish came from the planting of 1932 eggs. How successfully the stock will develop remains, of course, to be seen. Perhaps the large size of the trout population and the questionable abundance of plankton may interfere with the growth of the run. Time must give the answers but the initial step in geting Sockeye into the river system has apparently succeeded.

BAIRD FISH CULTURE STATION NOW CLOSED

Famed Base Operated for 65 Years Gives Way to Power and Irrigation Works.

(News item from the Washington STAR, March 13, 1938)

The famous Baird fish culture station, operated continuously for 65 years, through the entire period of Federal fish cultural work, has been closed as a result of power and irrigation development in the Sacramento Valley of California, the Commerce Department announced yesterday.

The Baird station, established in 1872 by Prof. Spencer F. Baird, pioneer fish culturist, who was assigned by the Smithsonian Institution to organize the new United States Commission of Fisheries, is regarded as a landmark in the propagation of fish and stocking of streams.

The Baird station recently was turned over by executive order from the Bureau of Fisheries to the Bureau of Reclamation. The hatchery work is to be continued at existing substations at Mill Creek and Battle Creek, in the general territory of the abandoned station.

The following quotation is extracted from the Report of Spencer F. Baird, U. S. Commissioner of Fisheries, for 1872-73:

PROPAGATION OF THE CALIFORNIA SALMON IN 1872

"Although considerable diversity of opinion exists with reference to the California salmon, most of those familiar with both species consider it nearly, if not quite, equal to the eastern salmon, and in some respects superior to it At any rate, it possesses the advantages of existing in great abundance in our country, and of thriving in water, the temperature of which might not admit of the existence of the eastern species.

"Accordingly, . . . Mr. Livingston Stone was engaged to undertake this work, and proceeded to California as soon as he could arrange his affairs for the purpose. The experiment was of course uncertain, in the entire absence of any reliable information bearing upon the natural history of the species. It was not even known at what period they spawned, although Mr. Stone was assured by professed experts, on his arrival in California, that this occurs late in the month of September. This was thought the more probable, since the other salmon usually deposits its eggs in the end of October or the beginning of November. Mr. Stone left on the 1st of August (1872), and arrived in due time in California, where, at my request, he reported to Mr. Throckmorton and the other fish-commissioners of the State, as well as to the president of the California Fish-Culturists' Association. By all of these gentlemen he was received with the utmost courtesy and kindness, and every assistance was rendered him. His instructions authorized him to select any point on the Sacramento or the Columbia River that promised to answer best the purposes of his mission. Quartermaster-General Meigs had supplied him with letters of recommendation to the officers of his department in the West; but, to his regret, Mr. Stone found no military post sufficiently near to render him any particular assistance during the present season.

"After much fruitless inquiry, Mr. Stone at last learned, chiefly through Mr. B. B. Redding, fish-commissioner of California, and through the chief engineer of the Central Pacific Railroad, that the Indians speared salmon on the McCloud River, a stream of the Sierra Nevada, emptying into Pitt River three hundred and twenty miles nearly due north of San Francisco. Proceeding to this station, in company with M. John G. Woodbury, of the Acclimatization Society, Mr. Stone immediately set to work in erecting the necessary hatching establishment, although, on account of the

distance from any settlement and the absence of special facilities, he found the undertaking both difficult and expensive. The efforts of Mr. Stone and his party were prosecuted unintermittingly, day and night, for a sufficient length of time to prove that the season had almost entirely passed, and that but few spawning fish remained. Many thousands of spawn were secured, however, and placed in hatching-troughs; but the extraordinary heat of the season, rising day after day to 110 and 112 in the shade, finally accomplished the destruction of the greater portion.

"The surviving eggs collected by Mr. Stone (30,000 in number) were packed by him in moss and forwarded October 26 by express, addressed to his establishment at Charlestown, N. H., this designation being selected in the failure to reach him, of a letter directing their transmission to Dr. Slack, at Bloomsbury, N. J. On receiving a telegraphic dispatch announcing the shipment, I immediately telegraphed to Charlestown, directing the packages to be forwarded at once to Dr. Slack, and sent also a telegram to the office of Wells, Fargo & Co., at Albany, requesting that, if the eggs but had not already passed that point, they might be intercepted there and returned at once to New Jersey. This dispatch came too late, as the eggs had passed when it was received, but the superintendent of Mr. Stone's establishment forthwith sent the eggs to New Jersey, with a skilled assistant to take charge of them and deliver them at their destination. Unfortunately, in consequence of the warmth, and through a miscalculation of the rapidity with which they accomplished their changes, the eggs were in large part hatched out on the journey, so that of the 30,000 originally shipped all but about 7,000 were hatched. The remainder were immediately picked out and placed in the hatching-house by Dr. Slack. The brood proved to be unusually hardy, very few dying, and all manifesting an extraordinary voracity for the food supplied to them.

"The surprise of Mr. Stone at finding the extraordinarily high temperature in the Sacramento Valley, just referred to, was all the greater from the fact that he had been warned against being blockaded with snow during the same period. It is, therefore, probable that, as the season of 1872 was exceptionally warm, this obstacle to success will not continue on a subsequent occasion.

"From Mr. Stone's experiences in 1872 he concluded that it will be necessary to commence operations as early as the 20th of July, and to have the breeding salmon caught and confined as early as the 20th of August. The hatching-water he proposes to take from the McCloud River, which is of so even a temperature that, notwithstanding the great heat, it does not rise above 54°. He would have used this water for hatching purposes in 1871 but for fear of its rising by sudden freshets so as to destroy the establishment. He found, however, that the water altered only about two

inches during his stay, and should operations be continued another season he proposes to employ it for the purpose, continuing operations at the same station. No better place is, indeed, to be had in California than the McCloud, as it is a very clear, cold swift-running stream, full of salmon, and probably embraces the principal spawning-ground of that fish.

"The spawning-beds lower down the river have been almost entirely destroyed by the washings of gravel and sand from the gold-diggings, which have exercised an unfavorable influence upon the supply.

"According to Mr. Stone there are no white settlements on the river; but the Indians are numerous. The nearest highway is the Oregon stage-road, four miles from the river. Mr. Stone's party endeavored to enlist the Indians in their service, but were unable to communicate intelligently with them, and were obliged to rely upon their own resources. As it was, their operations were somewhat delayed by the non-arrival of a salmon-net which had been sent for. Mr. Stone had been assured that there would be no difficulty in securing aid from the Indians, which, however, he found to be entirely impossible."

The foregoing recital of the trials and tribulations of an old-timer is quoted because of the fact that in late February, 1938, an Executive Order transferred the Baird, Calif., Station to the custody of the Bureau of Reclamation.

The Baird hatchery was the outgrowth of Livingston Stone's pioneering. It has been a land mark in West Coast fish cultural work for over a half century and its closure presents an opportunity for some moralizing. Many of the leading fish culturists in the Bureau's service have had a period of service at Baird. Throughout the years new developments have arisen which have greatly affected the operations. Among the vicissitudes encountered was volcanic action which discharged tremendous amounts of debris into the McCloud River, the source of the hatchery water supply, and seriously affected its usefulness. Irrigation ditches, mining operations (which appeared to be a problem even in 1872), and the increasing intensity of commercial fisheries were obstacles to be coped with. The crowning blow, however, was the proposed Central Valley Irrigation and Power Project which would place the hatchery itself under water. Thus we have another example of the effect of hydro-electric development upon fisheries conservation.

A number of years after the Baird hatchery was developed, the work was expanded by the opening of substations at Mill Creek and Battle Creek, Calif., in the same area. These will be continued in operation with a hope that they will maintain the Sacramento run of salmon in spite of the forced closure of the country's first and longest-lived hatchery devoted to the propagation of the Pacific salmon.

M. C. James.

5907

REVIEWS

TROUT MORTALITY FROM THE FORMATION OF SUSPENDED ICE CRYSTALS.

By Dr. Erich Tack, Fischerei-Zeitung, Vol. 41, No. 4, Jan. 23, 1938, p. 42.

A curious case of injury to trout is reported in this article. A pond containing several thousand rainbow fingerlings was subjected to a sudden overnight freeze combined with a high wind which whipped the surface of the water all night long. In the morning many of the trout were seen to be swimming about excitedly. After a period of violent struggle they would float on their sides or sink exhausted to the bottom. Examination of the fish showed their months and gills to be plugged with irregular masses of ice, sufficiently so to cause asphyxiation.

The explanation seemed to be that the high wind, together with a rather strong current through the pond, had combined to prevent a layer of ice from forming at the surface of the water in the usual manner. Instead, a mass of loose ice crystals had been mixed through the water to a considerable depth. Probably some of these crystals lodged in the mouth and against the gills, rapidly entangled other crystals so that eventually a large mass of ice was formed.

Distressed fish which were carried into the hatchery and thawed out in a slightly warmer water quickly recovered. Upon the wind dying down the trouble in the pond quickly abated, and no more fish were injured. About one hundred were lost in all.

In a neighboring pond the same conditions prevailed, but it was stocked with larger fish and these experienced no difficulty from the crystals.

L. E. Wolf.

MEAT SUBSTITUTES FOR FEEDING TROUT

By Heinz Vetter, Allgemeine Fischerei-Zeitung, Vol. 63, No. 2, Jan. 15, 1938.

The author is of the opinion that raw, or freshly cooked, meat is still the best food for trout, but owing to the high price of meat, and difficulty of obtaining it, he has experimented with the production and use of substitutes.

The best substitute yet produced is a meat mixture which is now being made up in the slaughter houses, and is sent to the fish culturists in an almost ready-to-feed condition.

At the slaughter houses the meat (mostly such as has been declared unfit for human consumption by the meat inspectors) is ground up raw, and then cooked quickly in boiling water. To this cooked, chopped meat are added wheat bran, beech-wood saw dust and diatomaceous earth. The dry components are added to the meat in sufficient quantities to produce a mixture which requires only a little further drying at a low temperature to be ready for shipment.

The fish culturists uses this in two ways: (1) Cooked fresh shrimp are added to the mixture in the proportion about 1 part to 3. The complete product is then run once or twice through a grinder. (2) If raw meat is available this is used in place of the shrimp, making a product which holds together better than the shrimp mixture.

These preparations are fed in the same quantities as if all raw meat were used.

Some of the ingredients in the above formula sound strange to American ears, especially the saw dust and diatomaceous earth. Concerning the latter this reviewer has no information, but numerous German investigators have shown that the addition of beech saw dust to trout feed has a decidedly beneficial effect. Opinion is divided as to just why this should be so, nevertheless it seems to be well substantiated.

L. E. Wolf.

PRODUCTION OF NUTRITIONAL CATARACT IN TROUT

By Walter N. Hess, Proceedings of the Society for Experimental Biology and Medicine, 1937, 37, 306-309.

Abstract

The investigation herein described was undertaken to determine whether cataract noticed in trout at several of the hatcheries of New York State was due to a contagious infection or whether such factors as diet, heredity, or light were the cause. The disease manifested itself by distinct opacities in both lenses of the eyes of trout 6 months of age or older, and was accompanied as well by degenerative changes in the fins, scales or iris of the eye.

Fish of two different ages (2½ and 4 months old, respectively) were used in the experiments. With the exception of part of the younger fish, which were hatched from trout seined from Seneca Lake, all were hatchery stock. Eight experiments were set up, and the fish were divided into sixteen groups, i.e., one experimental and one control lot for each experiment. The possibility of contagion was tested by placing normal fish in a pond with diseased fish for a period of four months. Other factors tested were various diets, including pig spleen alone, 2 parts pig spleen and one

part beef liver and beef heart, and a control diet of equal parts beef liver and beef heart; amount of light (varied by covering the troughs or leaving them uncovered and varying the depth of water); painting the inside black or white, and heredity.

After four months' association, none of the cataract-free trout placed with the diseased fish had developed cataract, and it is therefore concluded that the type of cataract under investigation is not of a contagious nature.

Cataract appeared in all groups that were fed exclusively on spleen, while none of the liver-heart fish, irrespective of other conditions, showed any trace of cataract. The occurrence of cataract among the groups fed exclusively on spleen was 13.7 percent among the older fish and 20.2 percent among the younger fish. No opacities appeared in the lenses of fish given the spleen-liver-heart diet. From this fact it may be concluded that a dietary deficiency, rather than any toxic substance, is responsible for the production of cataract.

R.L.C.

5907